

WHAT IS CLAIMED IS:

1. A semiconductor device comprising:

a semiconductor substrate; and

a bonding pad portion formed on said semiconductor substrate, said

5 bonding pad portion comprising:

an insulating film formed on said semiconductor substrate and a

first-level conductive pad layer of a large island shape formed on said insulating film;

first-level to (n-1)-level (n is an integer of 3 or larger) interlayer insulating films formed on and over said insulating film;

10 second-level to n-level conductive pad layers formed on said interlayer insulating films in areas generally corresponding to an area where said first conductive pad layer was formed;

a plurality of small diameter first through holes from the first-level to (n-1) level formed through said first-level to (n-1) level interlayer insulating films in
15 areas generally corresponding to an area where said first conductive pad layer;

a plurality of first contact plugs filled in said small diameter first through holes from the first-level to (n-1)-level, said first contact plugs at each level being conductive and electrically connecting two conductive pad layers adjacent along a normal to a surface of said semiconductor substrate, among said first-level to n-level
20 conductive pad layers disposed in and on said first-level to (n-1)-level interlayer insulating films;

an n-level interlayer insulating film formed on said (n-1)-level interlayer insulating film and covering said n-level conductive pad;

a large diameter through hole formed through said n-level interlayer insulating film in an area corresponding to an area where said n-level conductive pad
25 was formed, said large diameter through hole having a size corresponding to said

n-level conductive pad to expose a substantial upper surface of said n-level conductive pad; and

a bonding pad formed on said n-level interlayer insulating film and n-level conductive pad via said large diameter through hole.

5

2. A semiconductor device according to claim 1, further comprising a wiring portion comprising:

first-level to n-level wiring layers formed on and over said semiconductor substrate at same levels as said first-level to n-level conductive pad layers;

a highest-level wiring layer formed on said n-level interlayer insulating film;

small diameter second through holes formed through said first-level to n-level interlayer insulating films; and

a plurality of second contact plugs filled in said small diameter second through hole from the first-level to n-level, said second contact plug at each level being conductive and electrically connecting two wiring layers adjacent along a normal to the surface of said semiconductor substrate, among said first-level to n-level wiring layers disposed in and on said first-level to n-level interlayer insulating films.

20

3. A semiconductor device according to claim 2, further comprising wiring patterns for connecting said bonding pad layer and said wiring layer at a same-level.

4. A semiconductor device according to claim 3, wherein said interlayer insulating film includes a coated insulating film.

25

5. A semiconductor device according to claim 4, wherein said bonding pad portion is formed around said wiring portion.

6. A semiconductor device according to claim 4, wherein said conductive pad layer includes a Ti layer, an Al-Cu alloy layer and a TiN layer.

7. A semiconductor device according to claim 4, wherein said conductive pad layer includes an Al-Cu alloy layer and a TiN layer.

8. A semiconductor device according to claim 4, wherein a diameter of said small diameter first through hole is two times or smaller than a diameter of said small diameter second through hole.

9. A semiconductor device according to claim 4, wherein said first and second contact plugs are made of W.

10. A semiconductor device according to claim 4, wherein said first and second contact plugs each comprise:

a first layer of Ti, Ti/TiN or TiN covering an inner surface of each of said small diameter first and second through holes; and
W layer formed thereon.

11. A semiconductor device according to claim 4, wherein said interlayer insulating film contains silicon oxide.

12. A semiconductor device according to claim 4, wherein a silicon oxide

film and a silicon nitride film are formed on said n-level interlayer insulating film.

13. A method of manufacturing a semiconductor device, comprising the steps of:

- 5 (a) forming an insulating film on a semiconductor substrate;
- (b) forming first conductive pads of a large island shape on the insulating film;
- (c) forming a first interlayer insulating film on the insulating film, the first interlayer insulating film covering the first conductive pad layer;
- 10 (d) forming a second conductive pad layer on the first interlayer insulating film in an area corresponding to the first conductive pad layer;
- (e) forming a small diameter first through hole through the first interlayer insulating film in an area corresponding to an area where the first conductive pad layer was formed;
- 15 (f) filling a conductive first contact plug in the small diameter first contact hole to electrically connecting the first and second conductive pad layers;
- (g) sequentially repeating said steps (c) to (f) to form second-level to n-level (n is an integer of 3 or larger) conductive pad layers and second-level to (n-1)-level interlayer insulating films and electrically connect two conductive pad
- 20 layers adjacent along a normal to a surface of the semiconductor substrate;
- (h) forming an n-level interlayer insulating film on the (n-1)-level interlayer insulating film;
- (i) forming a large diameter through hole through the n-level interlayer insulating film, the large diameter through hole having generally a same size as the
- 25 n-level conductive pad layer; and
- (j) forming a bonding pad on the n-level interlayer insulating film, the

bonding pad being electrically connected to the n-level conductive pad layer via the large diameter through hole.

14. A method of manufacturing a semiconductor device according to claim
5 13, further comprising a step of:

(h) forming a passivation film on the n-level interlayer insulating film, the passivation film exposing the bonding pad, after said step (j).

15. A method of manufacturing a semiconductor device according to claim
10 14, wherein said step (h) forms a silicon oxide film and a silicon nitride film.

16. A method of manufacturing a semiconductor device according to claim
13, wherein said step (c) of forming the first interlayer insulating film comprises the steps of:

15 forming a silicon oxide film;
coating hydrogen silsesquioxane resin on the silicon oxide film;
thermally treating the hydrogen silsesquioxane to form a first ceramic
silicon oxide film; and
forming a thick silicon oxide film on the first silicon oxide film by plasma

20 CVD.

17. A method of manufacturing a semiconductor device according to claim
16, further comprising a step of planarizing the second silicon oxide film by CMP.

25 18. A method of manufacturing a semiconductor device according to claim
16, further comprising a step of planarizing the second silicon oxide film by etching.

19. A method of manufacturing a semiconductor device according to claim 13, wherein said step (f) comprises the steps of:

forming a Ti interlayer insulating film covering an inner surface of the small diameter first through hole;

5 forming a TiN layer on the Ti interlayer insulating film; and
forming a W layer on the TiN layer.

sub Br
20. A method of manufacturing a semiconductor device according to claim 13, wherein said step (f) comprises the steps of:

10 forming a Ti interlayer insulating film covering an inner surface of the small diameter first through hole by sputtering;

forming a TiN layer on the Ti interlayer insulating film by sputtering; and
forming a W layer on the TiN layer.

15 21. A method of manufacturing a semiconductor device according to claim 13, wherein said step (f) comprises the steps of:

forming a Ti interlayer insulating film covering an inner surface of the small diameter first through hole;

20 forming a TiN layer on the Ti interlayer insulating film; and
forming a W layer on the TiN layer by blanket CVD.

22. A method of manufacturing a semiconductor device according to claim 13, wherein said step of forming the conductive pad layer comprises the steps of:

25 forming a Ti layer;
forming an Al-Cu alloy layer;
forming a Ti layer; and

forming a TiN layer.

sub B2 cont.

ADD B3